

Scotland's Rural College

Soil biota, carbon cycling and crop plant biomass responses to biochar in a temperate mesocosm experiment

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Supplementary information

Fig.1S Layout of 72 mesocosms assigned to three experimental treatments: 1) biochar (+ or – at 2 % w/w); 2) crop type (barley, perennial ryegrass, or unvegetated); and 3) soil texture (sandy clay, sandy silt loam, clay loam) placed in an outdoor enclosure at the Centre for Ecology and Hydrology (CEH) in Penicuik, UK (55° 51' N, 3° 12' W, 189 metres above sea level).



Table 1S. Spearman correlation coefficients between edaphic properties, plant biomass and the soil biota. * $P < 0.05$, ** $P < 0.01$ and *** $P < 0.001$.

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Table 2S. All tests from a linear mixed model (LMM) of the response of soil carbon content (total C and adjusted C_A to account for the proportion of C added to the soil as biochar) to experimental treatments and covariates. Values are estimates of fixed effects and type III (adjusted for other significant terms) *F* & *p* statistics $\alpha = 0.05$. Annual measurements of soil carbon (n = 3) at the mesocosm level were accounted for using an autoregressive AR(1) structure. \times = interaction. Biochar (+) vs Control (-); SZL: sandy silt loam, CL: clay loam, SC: sandy clay; Collembola, Acari or Nematoda = density of these soil invertebrates. Bold text indicates significant terms retained in final LMM $\alpha = 0.05$, interactions only reported where significant or marginally non-significant (i.e. *p* = 0.05).

Response	Fixed effect	Class	Estimate	<i>F</i> _(ndf, ddf)	<i>p</i>
Soil carbon (C) content % Random effects: Spatial block = 0.0005 Mesocosm AR(1) = 0.008 Residual variance = 0.278	Intercept		2.385 ± 0.236		
	Soil texture	SZL	1.59 ± 0.17	63.04 _(2,125)	< 0.0001
		CL	0.78 ± 0.18		
		SC	0		
	Biochar	+	0.82 ± 0.13	155.33 _(1,71)	< 0.0001
		-	0		
	Nematoda		-0.0004 ± 0.021	6.80 _(1,182)	0.010
	Crop type	Barley	-0.59 ± 0.28	3.94 _(2,69)	0.024
		Ryegrass	0.13 ± 0.28		
		Unvegetated	0		
	Fungi:bacteria		-0.74 ± 0.48	0.02 _(1,69)	0.884
	Biochar ×	+ × SZL	-0.14 ± 0.19	7.28 _(2,72)	0.001
	Soil texture	+ × CL	0.55 ± 0.19		
		+ × SC	0		
		- × SZL	0		
		- × CL	0		
		- × SC	0		
	Nematoda ×	SZL	0.006 ± 0.032	4.72 _(2,182)	0.010
	Soil texture	CL	-0.201 ± 0.070		
		SC	0		
	Fungi:bacteria × crop type	Barley	1.56 ± 0.64	3.18 _(2,70)	0.048
		Ryegrass	0.56 ± 0.54		
		Unvegetated	0		
	Year			0.43 _(2,133)	0.650
	Collembola			2.16 _(1,76)	0.145
	Acari			0.32 _(1,68)	0.576
	Crop biomass			0.06 _(1,171)	0.804
	Soil moisture			0.07 _(1,181)	0.795
	Soil N content %			0.00 _(1,102)	0.996
Adjusted soil C_A content % Random effects estimate: Spatial block = 0 Mesocosm AR(1) = 0.073 Residual variance = 0.287	Soil texture	SZL	1.60 ± 0.13	128.00 _(2,77)	< 0.0001
		CL	0.58 ± 0.13		
		SC	0		
	Biochar	+	-0.71 ± 0.13	63.62 _(1,77)	< 0.0001
		-	0		
	Collembola		0.78 ± 0.29	7.25 _(1,78)	0.009
	Biochar ×	+ × SZL	-0.141 ± 0.189	4.26 _(2,78)	0.018
	Soil texture	+ × CL	0.403 ± 0.190		
		+ × SC	0		
		- × SZL	0		
		- × CL	0		
		- × SC	0		
	Nematoda			0.27 _(1,196)	0.605
	Acari			0.00 _(1,74)	0.957
	Crop biomass			0.01 _(1,202)	0.933
	Soil moisture			0.01 _(1,193)	0.942
	Year			0.17 _(2,141)	0.845
	Soil N content %			0.10 _(1,105)	0.747

Table 3S. All tests from a linear mixed model (LMM) of the response of soil microbial biomass (PLFA analysis) to experimental treatments and covariates. Values are estimates of fixed effects and type III (adjusted for other significant terms) *F* & *p* statistics $\alpha = 0.05$. \times = interaction. Biochar (+) vs Control (-); SZL: sandy silt loam, CL: clay loam, SC: sandy clay; Collembola, Acari or Nematoda = density of these soil invertebrates. Bold text indicates significant terms retained in final LMM $\alpha = 0.05$, interactions only reported where significant or marginally (i.e. $p = 0.05$) non-significant.

Response	Fixed effect	Class	Estimate	<i>F</i> _(ndf, ddf)	<i>p</i>
Fungal-to-bacterial ratio Random effects: Spatial block = 0 Residual variance = 0.024	Intercept		3.709 ± 1.126		
	Crop type	Barley	-0.752 ± 0.439	3.00 _(2,54)	0.058
		Ryegrass	-1.097 ± 0.466		
		Unvegetated	0		
	Soil texture	SZL	2.306 ± 0.588	8.70 _(2,54)	0.0005
		CL	1.559 ± 0.583		
		SC	0		
	Biochar	+	0.196 ± 0.067	8.53 _(1,54)	0.005
		-	0		
	Acari		0.016 ± 0.345	3.01 _(1,54)	0.089
	Soil pH		-0.673 ± 0.204	10.92 _(1,54)	0.002
	Soil N content		-0.958 ± 1.950	4.22 _(1,54)	0.045
	Soil moisture		0.045 ± 0.024	1.68 _(1,54)	0.201
	Acari × crop type	Barley	-0.507 ± 0.413	10.77 _(2,54)	0.0001
		Ryegrass	1.468 ± 0.467		
		Unvegetated	0		
	Soil N content × crop type	Barley	4.977 ± 2.444	3.77 _(2,54)	0.029
		Ryegrass	6.610 ± 2.538		
		Unvegetated	0		
	Soil moisture × soil texture	SZL	-0.131 ± 0.041	5.59 _(2,54)	0.006
		CL	-0.083 ± 0.040		
		SC	0		
	Crop biomass			0.00 _(1,51)	0.966
	Nematoda			0.82 _(1,53)	0.369
	Collembola			0.01 _(1,53)	0.908
Total PLFA Random effects: Spatial block = 0 Residual variance = 2.17 × 10 ⁷	Intercept		35800 ± 1900		
	Crop type	Barley	5055 ± 2624	25.61 _(2,60)	< 0.0001
		Ryegrass	14366 ± 2981		
		Unvegetated	0		
	Soil texture	SZL	-12081 ± 2684	19.17 _(2,60)	<0.0001
		CL	-6909 ± 2336		
		SC	0		
	Biochar			0.10 _(1,59)	0.754
	Acari			1.99 _(1,60)	0.163
	Crop type × soil texture	Barley × SZL	10302 ± 3624	5.84 _(4,60)	0.0005
		Barley × CL	-906 ± 3300		
		Barley × SC	0		
		Ryegrass × SZL	12654 ± 3575		
		Ryegrass × CL	-3388 ± 3302		
		Ryegrass × SC	0		
		Unvegetated × SZL	0		
		Unvegetated × CL	0		
		Unvegetated × SC	0		
	Acari × crop type	Barley	-33154 ± 12770	8.44 _(2,60)	0.0006
		Ryegrass	15143 ± 13916		
		Unvegetated	0		
	Soil pH			0.53 _(1,59)	0.469
	Soil N content			0.09 _(1,59)	0.763
	Soil moisture			0.24 _(1,57)	0.623
	Crop biomass			0.05 _(1,57)	0.828

	Nematoda			0.74 _(1,57)	0.393
	Collembola			0.09 _(1,59)	0.761
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Arbuscular Mycorrhizal Fungi (AMF 16:105)	Intercept		978.8 ± 143.2		
Random effects:	Biochar	+	-6.5 ± 78.2	0.01 _(1,64)	0.934
Spatial block = 0		-	0		
Residual variance = 39218	Crop type	Barley	281.3 ± 57.5	114.78 _(2,64)	< 0.0001
		Ryegrass	947.2 ± 63.5		
		Unvegetated	0		
	Soil texture	SZL	-194.8 ± 58.8	5.65 _(2,64)	0.006
		CL	-68.4 ± 58.6		
		SC	0		
	Collembola		-303.6 ± 271.8	0.47 _(1,64)	0.500
	Collembola × biochar	+	870.0 ± 345.3	6.35 _(1,64)	0.014
		-	0		
	Soil pH			1.84 _(1,63)	0.180
	Acari			0.12 _(1,63)	0.727
	Soil N content			0.16 _(1,63)	0.691
	Soil moisture			2.04 _(1,61)	0.158
	Crop biomass			2.96 _(1,61)	0.090
	Nematoda			1.77 _(1,61)	0.188
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Table 4S. All tests from a linear mixed model (LMM) of the response of soil invertebrate densities (n g^{-1} soil) to experimental treatments and covariates. Values are estimates of fixed effects and type III (adjusted for other significant terms) F & p statistics $\alpha=0.05$. Annual measurements of nematoda ($n = 3$) at the mesocosm level were accounted for using an autoregressive AR(1) structure. \times = interaction. Biochar (+) vs Control (-); SZL: sandy silt loam, CL: clay loam, SC: sandy clay; Collembola, Acari or Nematoda = density of these soil invertebrates. Bold text indicates significant terms retained in final LMM $\alpha=0.05$, interactions only reported where significant or marginally (i.e. $p = 0.05$) non-significant.

Response	Fixed effect	Class	Estimate	$F_{(\text{ndf}, \text{ddf})}$	p
Nematode density	Intercept		0.887 ± 0.279		
Random effects:	Soil texture	SZL	-1.121 ± 0.291	11.38_(2,150)	<0.0001
Spatial block = 0.004		CL	-1.737 ± 0.320		
Mesocosm AR(1) = -0.043		SC	0		
Residual variance = 0.094	Crop type	Barley	-0.169 ± 0.088	11.78_(2,91)	<0.0001
		Ryegrass	0.004 ± 0.091		
		Unvegetated	0		
	Biochar	+	-0.090	4.00 _(1,97)	0.048
		-	0		
	Soil moisture		-0.008 ± 0.012	7.28_(1,187)	0.008
	Year	2011	-0.037 ± 0.097	10.45_(2,188)	<0.0001
		2012	-0.420 ± 0.145		
		2013	0		
	Soil N content			0.000 _(1,184)	0.985
	Soil moisture	SZL	0.040 ± 0.015	12.24_(2,188)	<0.0001
	\times soil texture	CL	0.086 ± 0.018		
		SC	0		
	Plant type	Barley \times SZL	0.403 ± 0.125	4.86_(4,84)	0.001
	\times soil texture	Barley \times CL	0.383 ± 0.124		
		Barley \times SC	0		
		Ryegrass \times SZL	0.483 ± 0.128		
		Ryegrass \times CL	0.318 ± 0.131		
		Ryegrass \times SC	0		
		Unvegetated \times SZL	0		
		Unvegetated \times CL	0		
		Unvegetated \times SC	0		
	Soil N content	SZL	-0.188 ± 0.802	3.14 _(2,124)	0.047
	\times soil texture	CL	-1.959 ± 0.846		
		SC	0		
	Collembola			3.39 _(1,80)	0.069
	Soil pH			0.41 _(1,178)	0.523
	Crop biomass			0.06 _(1,176)	0.810
	Fungi:bacteria			1.03 _(1,77)	0.312
	Acari			0.57 _(1,78)	0.452
Collembolan density	Intercept		-0.272 ± 0.856		
Random effects:	Crop type	Barley	0.009 ± 0.037	9.64_(2,64)	0.0002
Spatial block = 0		Ryegrass	0.140 ± 0.036		
Residual variance = 0.014		Unvegetated	0		
	Soil pH		0.062 ± 0.146	0.98 _(1,64)	0.327
	Soil texture	SZL	1.640 ± 1.400	3.94_(2,64)	0.024
		CL	-1.953 ± 1.152		
		SC	0		
	Soil texture \times pH	SZL	-0.248 ± 0.224	3.97_(2,64)	0.024
		CL	0.315 ± 0.190		
		SC	0		
	Biochar			0.34 _(1,63)	0.560
	Crop biomass			3.12 _(1,61)	0.082
	Soil N content			0.24 _(1,63)	0.627
	Fungi:bacteria			0.30 _(1,63)	0.586
	Soil moisture			1.36 _(1,61)	0.248
	Acari			2.40 _(1,63)	0.127

Mite density

Random effects:

Spatial block = 0.0004

Residual variance =
0.0131

Crop type

Soil texture

Biochar

Crop biomass

Fungi:bacteria

Soil pH

Soil moisture

Soil N content

Collembola

0.58_(2,68)2.48_(2,68)0.07_(1,69)1.86_(1,67)1.64_(1,69)3.28_(1,69)1.31_(1,68)1.84_(1,69)0.65_(1,69)

0.561

0.091

0.799

0.177

0.204

0.074

0.257

0.179

0.424

Table 5S. All tests from a linear mixed model (LMM) of the response of plant biomass (n g^{-1} soil) to experimental treatments and covariates. Values are estimates of fixed effects and type III (adjusted for other significant terms) F & p statistics $\alpha = 0.05$. Yearly measurements of aboveground plant biomass ($n = 3$) at the mesocosm level were accounted for using an autoregressive AR(1) structure. \times = interaction. Biochar (+) vs Control (-); SZL: sandy silt loam, CL: clay loam, SC: sandy clay; Collembola, Acari or Nematoda = density of these soil invertebrates. Bold text indicates significant terms retained in final LMM $\alpha = 0.05$, interactions only reported where significant or marginally (i.e. $p = 0.05$) non-significant.

Response	Fixed effect	Class	Estimate	$F_{(\text{ndf}, \text{ddf})}$	p
Aboveground plant biomass	Intercept		0.831 ± 0.238		
Random effects:	Crop type	Barley	0.896 ± 0.194	21.31 _(1,113)	<0.0001
Spatial block = 0.0007		Ryegrass	0		
Mesocosm AR(1) = 0.087	Soil texture	SZL	-0.378 ± 0.157	6.68 _(2,101)	0.002
Residual variance = 0.043		CL	-0.531 ± 0.148		
		SC	0		
	Year	2011	-0.258 ± 0.081	38.17 _(2,118)	<0.0001
		2012	-0.918 ± 0.114		
		2013	0		
	Soil moisture		-0.003 ± 0.010	4.61 _(1,117)	0.034
	Nematoda		-0.024 ± 0.009	7.98 _(1,118)	0.006
	Acari		0.929 ± 0.573	4.52 _(1,58)	0.038
	Soil nitrogen content			1.08 _(1,117)	0.300
	Soil moisture \times crop type	Barley	0.041 ± 0.010	17.77 _(1,115)	<0.0001
		Ryegrass	0		
	Nitrogen content \times crop type	Barley	-6.57 ± 0.546	97.9 _(1,145)	<0.0001
		Ryegrass	0		
	Nitrogen content \times soil texture	SZL	1.414 ± 0.601	6.67 _(2,79)	0.002
		CL	2.338 ± 0.661		
		SC	0		
	Acari \times crop type	Barley	0.885 ± 0.428	4.27 _(1,58)	0.043
		Ryegrass	0		
	Acari \times soil texture	SZL	-1.641 ± 0.605	3.68 _(2,57)	0.031
		CL	-1.135 ± 0.581		
		SC	0		
	Collembola			0.43 _(1,57)	0.512
	Fungi:bacteria			2.29 _(1,53)	0.136
	Biochar	+/-		0.19 _(1,62)	0.666
	Soil pH			0.05 _(1,89)	0.823
Root biomass	Intercept		0.0006 ± 0.0009		
Random effects:	Crop type	Barley	-0.0003 ± 0.001	0.23 _(1,30)	0.638
Spatial block = 0		Ryegrass	0		
Residual variance = 1.39 E-6	Soil texture	SZL	0.0006 ± 0.0007	0.54 _(2,30)	0.590
		CL	-0.0001 ± 0.001		
		SC	0		
	Acari		-0.0027 ± 0.0044	1.62 _(1,52)	0.213
	Nematoda		-0.0001 ± 0.0001	2.85 _(1,30)	0.102
	Acari \times soil texture	SZL	0.018 ± 0.005	12.21 _(2,30)	0.0001
		CL	-0.001 ± 0.006		
		SC	0		
	Nematoda \times crop type	Barley	0.001 ± 0.001	7.48 _(1,30)	0.010
		Ryegrass	0		
	Fungi:bacteria			0.27 _(1,29)	0.608
	Biochar			0.10 _(1,29)	0.755
	Collembola			2.13 _(1,29)	0.155
	Soil moisture			0.13 _(1,30)	0.722
	Soil nitrogen content			0.02 _(1,30)	0.891
	Soil pH			0.01 _(1,29)	0.911

Table 6S. All tests from a linear mixed model (LMM) of the response of net ecosystem exchange and ecosystem respiration to treatments, covariates and their interactions. Net CO₂ efflux data were expressed as positive values whereas net CO₂ uptake data were expressed as negative values. Values are estimates of fixed effects and type III (adjusted for other significant terms) *F* & *p* statistics $\alpha = 0.05$. Repeated measures at the mesocosm level accounted for with an AR(1) autoregressive structure. \times = interaction. Biochar (+) vs Control (-); SZL: sandy silt loam, CL: clay loam, SC: sandy clay; Collembola, Acari or Nematoda = density of these soil invertebrates. Bold text indicates significant terms retained in final LMM $\alpha = 0.05$, interactions only reported where significant or marginally (i.e. $p = 0.05$) non-significant.

Response	Fixed effect	Class	Estimate	<i>F</i> _(ndf, ddf)	<i>p</i>
Net ecosystem exchange	Intercept		0.304 ± 0.274		
Random effects:	Crop type	Barley	-1.314 ± 0.377	6.07 _(2,299)	0.003
Spatial block = 0.00003		Ryegrass	-0.469 ± 0.364		
Mesocosm AR(1) = -0.091		Unvegetated	0		
Residual variance = 0.069	Sin(Julian day)		-0.010 ± 0.025	0.08 _(1,357)	0.779
	Cos(Julian day)		0.083 ± 0.021	308.39 _(1,378)	<0.0001
	Plant biomass		0.010 ± 0.003	7.92 _(1,316)	0.005
	Year	2011	-0.282 ± 0.031	41.95 _(2,323)	<0.0001
		2012	-0.033 ± 0.039		
		2013	0		
	Soil texture	SZL	0.033 ± 0.023	7.48 _(2,256)	0.001
		CL	0.088 ± 0.023		
		SC	0		
	Nematoda		0.007 ± 0.002	8.08 _(1,145)	0.005
	Soil pH		-0.031 ± 0.044	0.06 _(1,278)	0.803
	Soil N content		-0.719 ± 0.363	0.71 _(1,254)	0.399
	Sin(Julian day) × crop type	Barley	0.090 ± 0.027	6.16 _(2,357)	0.002
		Ryegrass	0.022 ± 0.026		
		Unvegetated	0		
	Cos(Julian day) × crop type	Barley	0.178 ± 0.023	61.59 _(2,376)	<0.0001
		Ryegrass	0.246 ± 0.023		
		Unvegetated	0		
	Sin(Julian day) × soil type	SZL	-0.026 ± 0.026	1.49 _(2,340)	0.226
		CL	-0.045 ± 0.026		
		SC	0		
	Cos(Julian day) × soil texture	SZL	-0.080 ± 0.023	10.37 _(2,380)	<0.0001
		CL	-0.097 ± 0.023		
		SC	0		
	Soil pH × crop type	Barley	0.133 ± 0.061	3.27 _(2,290)	0.039
		Ryegrass	-0.017 ± 0.059		
		Unvegetated	0		
	Soil N content × crop type	Barley	1.697 ± 0.269	21.05 _(2,338)	<0.0001
		Ryegrass	1.260 ± 0.282		
		Unvegetated	0		
	Biochar			0.037 _(1,261)	0.544
	Collembola			0.10 _(1,228)	0.748
	Acari			0.10 _(1,200)	0.757
	Fungi:bacteria			0.99 _(1,216)	0.321
	Soil moisture			0.06 _(1,284)	0.807
Ecosystem respiration	Intercept		0.044 ± 0.007		
Random effects:	Crop type	Barley	-0.007 ± 0.007	17.87 _(2,185)	<0.0001
Spatial block = 0		Ryegrass	-0.050 ± 0.008		
Mesocosm AR(1) = -0.25		Unvegetated	0		
Residual variance = 0.013	Sin(Julian day)		-0.034 ± 0.004	57.09 _(1,233)	<0.0001
	Cos(Julian day)		-0.008 ± 0.004	5.24 _(1,244)	0.023
	Plant biomass		0.004 ± 0.001	25.09 _(1,208)	<0.0001

Year	2011	-0.106 ± 0.011	55.76 _(2,274)	<0.0001
	2012	-0.055 ± 0.006		
	2013	0		
Nematoda		0.002 ± 0.001	6.38 _(1,200)	0.0123
Plant biomass × crop	Barley	-0.004 ± 0.001	22.49 _(1,207)	<0.0001
type	Ryegrass	0		
	Unvegetated	0		
Biochar			0.84 _(1,180)	0.362
Soil texture			1.21 _(2,180)	0.302
Acari			0.01 _(1,174)	0.916
Collembola			0.85 _(1,179)	0.357
Fungi:bacteria			0.01 _(1,175)	0.939
Soil pH			0.15 _(1,215)	0.702
Soil N content			0.16 _(1,179)	0.687
Soil moisture			1.25 _(1,195)	0.264

Table 7S. Raw values of soil fauna density, averaged across 72 mesocosms (mean \pm S.E.). Biochar (+) vs Control (-); SC: sandy clay; SZL: sandy silt loam, CL: clay loam.

	Nematoda (individuals g ⁻¹ soil)	Collembola (individuals g ⁻¹ soil)	Acari (individuals g ⁻¹ soil)
Biochar			
+	2.20 \pm 0.22	0.20 \pm 0.02	0.14 \pm 0.02
-	2.64 \pm 0.29	0.16 \pm 0.02	0.13 \pm 0.02
Crop type			
Barley	1.83 \pm 0.22	0.15 \pm 0.02	0.12 \pm 0.02
Ryegrass	3.47 \pm 0.37	0.27 \pm 0.02	0.14 \pm 0.02
Unvegetated	2.03 \pm 0.34	0.13 \pm 0.03	0.15 \pm 0.02
Soil texture			
SC	3.39 \pm 0.45	0.14 \pm 0.02	0.11 \pm 0.01
SZL	2.69 \pm 0.35	0.21 \pm 0.03	0.18 \pm 0.03
CL	1.16 \pm 0.09	0.20 \pm 0.03	0.11 \pm 0.02

Table 8S. Raw values of above- and belowground biomass, averaged across 72 mesocosms (mean \pm S.E.). Biochar (+) vs Control (-); SC: sandy clay; SZL: sandy silt loam, CL: clay loam.

	Aboveground biomass, barley (g ⁻¹ mesocosm)	Aboveground biomass, ryegrass (g ⁻¹ mesocosm)	Belowground biomass, barley (mg g ⁻¹ soil)	Belowground biomass, ryegrass (mg g ⁻¹ soil)
Biochar				
+	37.44 \pm 8.38	8.36 \pm 1.11	0.70 \pm 0.14	3.30 \pm 0.60
-	34.48 \pm 7.08	7.80 \pm 1.21	0.82 \pm 0.40	3.40 \pm 1.03
Soil texture				
SC	64.62 \pm 10.14	12.73 \pm 1.40	1.40 \pm 0.45	4.61 \pm 1.33
SZL	21.82 \pm 2.40	5.16 \pm 3.51	0.24 \pm 0.16	2.48 \pm 0.73
CL	24.45 \pm 7.07	6.10 \pm 1.17	0.68 \pm 0.18	2.67 \pm 0.56

Table 9S. Raw values of PLFA concentrations, averaged across 72 mesocosms (mean \pm S.E.). Biochar (+) vs Control (-); SC: sandy clay; SZL: sandy silt loam, CL: clay loam.

	Total PLFA (nmol g⁻¹ soil)	Fungal to Bacterial Ratio	AMF Fungal PLFA (nmol g⁻¹ soil)
Biochar			
+	39887 \pm 1963	0.51 \pm 0.04	1410 \pm 84.7
-	38854 \pm 1604	0.50 \pm 0.04	1252 \pm 68.6
Crop type			
Barley	35436 \pm 1193	0.42 \pm 0.03	1194 \pm 51
Ryegrass	51158 \pm 1504	0.69 \pm 0.06	1878 \pm 59
Unvegetated	31518 \pm 1273	0.41 \pm 0.03	921 \pm 28
Soil texture			
SC	43763 \pm 1884	0.43 \pm 0.03	1409 \pm 90
SZL	38930 \pm 2659	0.57 \pm 0.06	1214 \pm 98
CL	35419 \pm 1599	0.52 \pm 0.04	1370 \pm 97